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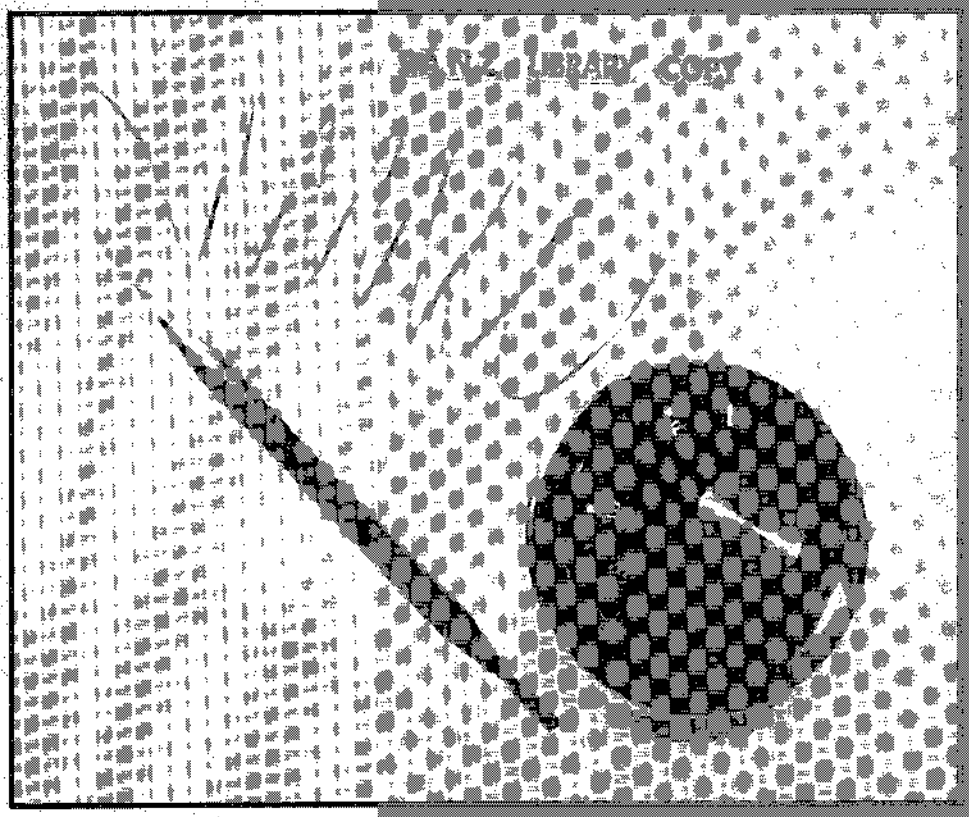

NEW ZEALAND STANDARD

THERMOSTATS AND THERMAL CUTOUTS FOR DOMESTIC THERMAL STORAGE ELECTRIC WATER HEATERS (A.C. ONLY)

Superseding NZS 2149:1967

UDC 621.316.54–524:696.48–65

Pr EE

Standards Association of New Zealand

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This Standard was prepared under the supervision of the Electrical Accessories and Appliances Sectional Committee (62/-) for the Standards Council, established under the Standards Act 1965. The committee consisted of representatives of the following:

*Consumers Institute
Department of Scientific and Industrial Research -
Physics and Engineering Laboratory
Southern Industrial Development Division
*Electric Supply Authority Engineers Institute of New Zealand
Institution of Professional Engineers New Zealand
Insurance Council of New Zealand Inc
*Ministry of Energy -
Electricity Division
Ministry of Works and Development
New Zealand Electric Range Manufacturers Association
New Zealand Electrical Contractors Federation
*New Zealand Electrical Manufacturers Federation
New Zealand Home Appliance Radio and TV Retailers Federation
*New Zealand Institute of Electricians
New Zealand Post Office
New Zealand Railways Corporation
Plastics Institute of New Zealand

The Thermostats for Electric Water Heaters Committee (62/17) was responsible for the preparation of the Standard and consisted of representatives of the following organizations in addition to those marked with an asterisk (*) above:

Department of Health
Electrical Development Association

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AMENDMENTS

Date of Issue	*Description*

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RELATED DOCUMENTS

Reference is made in this document to the following:

NEW ZEALAND STANDARD

NZS 6200:1988 General requirements for electrical apparatus and material

INTERNATIONAL ELECTROTECHNICAL COMMISSION

IEC 695:- Fire hazard testing

IEC 695-2:- Part 2. Test methods

IEC 695-2-1(1980) Glow-wire test and guidance

AUSTRALIAN STANDARDS

AS 1111:1980* ISO metric hexagon commercial bolts and screws

AS 2345:1980 An accelerated laboratory test method for assessment of the susceptibility of brass to dezincification

BRITISH STANDARD

BS 2779:1986* Pipe threads for tubes and fittings where pressure-tight joints are not made on the threads

NEW ZEALAND LEGISLATION

Radio Interference Regulations 1958

*Endorsed as suitable for use in New Zealand

The users of this Standard should ensure that their copies of the above-mentioned New Zealand Standards or of overseas Standards endorsed as suitable for use in New Zealand are the latest revisions or include the latest amendments. Such amendments are listed in the annual SANZ Catalogue which is supplemented by lists contained in the monthly magazine Standards issued free of charge to committee and subscribing members of SANZ.

FOREWORD

This Standard revises and supersedes NZS 2149:1967 Immersion type thermostats for thermal storage electric water heaters (a.c. only), and extends the scope to include contact type thermostats and thermal cutouts.

The revised Standard, which is less prescriptive and more performance orientated, takes into account recent views on the requirements of hot water heating systems particularly the safety-related aspects.

Recognition of the fact that water temperature affects the severity and outcome of burns has led in recent years to proposals for a reduction in the temperature at which water is available from hot water systems.

These proposals have revealed short-comings in thermostats designed to NZS 2149 in that adjustment by the consumer was prevented and that the thermostats performed less satisfactorily at these lower temperatures. Thermostats to the revised Standard will be user-adjustable down to at least 50 °C without loss of performance.

The thermal storage electric water heaters for which these thermostats and temperature cutouts are intended are specified in NZS 4602 (low pressure) and NZS 4606 (high pressure). The full titles of these Standards are given at the end of this Standard together with the related installation codes, NZS 4603 (open-vented systems) and NZS 4607 (valve-vented systems).

NOTES

NEW ZEALAND STANDARD

THERMOSTATS AND THERMAL CUTOUTS FOR DOMESTIC THERMAL STORAGE ELECTRIC WATER HEATERS (A.C. ONLY)

1
SCOPE

1.1
This Standard specifies the performance and corresponding test requirements for thermostats, for non-self-resetting thermal cutouts, and for combinations thereof, intended for use in domestic thermal storage electric water heaters.

2
DEFINITIONS

2.1
For the purposes of this Standard the following definitions shall apply:

(a) Terms relating to thermostats.

THERMOSTAT. A temperature-sensing device, the cutout temperature of which is adjustable by the user without the use of tools and which, during normal operation of the system, keeps the temperature of an appliance, or of parts of it, between certain limits by automatically opening and closing a circuit.

CONTACT THERMOSTAT. A thermostat intended for mounting on the surface of the container of a water heater.

IMMERSION THERMOSTAT. A thermostat intended for mounting so that the thermally responsive component is either immersed directly in the water or inserted into a pocket.

POCKET. A water-tight enclosure intended for fitting to the container of a water heater to accommodate the thermally responsive component of an immersion thermostat.

(b) Terms relating to thermal cutouts.

THERMAL CUTOUT. A device which, during abnormal operation of the system, limits the temperature of an appliance, or of parts of it, by automatically opening the circuit or by reducing the current, and which is so constructed that its setting cannot be altered by the user.

NOTE - Throughout this Standard, the term 'thermal cutout' is abbreviated to TCO. (The plural is TCOs.)

MULTIPOLE THERMAL CUTOUT. A TCO intended to open two or more circuits at a predetermined temperature.

NON-SELF-RESETTING THERMAL CUTOUT. A TCO which in order to restore the circuit to normal, requires resetting by hand.

(c) Terms relating to temperature.

CUT-IN TEMPERATURE. The temperature at which the contacts of a thermostat or TCO close when tested in accordance with Appendix A.

CUTOUT TEMPERATURE. The temperature at which the contacts of a thermostat or TCO open when tested in accordance with Appendix A.

TEMPERATURE DIFFERENTIAL. The difference between the cutout and cut-in temperatures of a thermostat or TCO.

TEMPERATURE RANGE. The difference between the highest and lowest nominal cutout temperatures to which a thermostat can be adjusted by the user.

3
CONSTRUCTION

3.1
Thermostats and TCOs shall be constructed in such a manner as will ensure adequate strength and durability to withstand the conditions of installation and service, and shall be supplied ready for attachment to a water heater.

3.2
Thermostats and TCOs should be rated at one of the following preferred values, in amperes:

10 16 20 25 32

3.3
Thermostats shall be so constructed that they can be fitted as replacement components for existing water heater thermostats.

3.4
Thermostats shall be constructed so as to permit consumer adjustment of the temperature setting without the use of tools, or the removal of covers or component parts of the water heater.

3.5
Provisions shall be made to prevent the thermostat being set at a temperature in excess of the upper limit marked on its scale.

4
TERMINATIONS

4.1
Thermostats and TCOs shall be provided with terminations for the connection of single-strand or multi-strand cables of current rating not less than the rating of the device, and suitably shrouded to prevent accidental body contact with live parts. Terminations shall be either:

(a) Terminals intended for making connections using ordinary tools; or

(b) Quick-connect tabs or receptacles.

5
DIMENSIONS AND MEANS OF ATTACHMENT

5.1
Thermostats and TCOs
An immersion thermostat shall be so designed that the thermally responsive component fits one of the pockets described in 5.2. Contact thermostats and TCOs shall conform to the dimensions specified, as follows:

(a) Clip-mounted units .....Fig. 5.1

(b) Stud-mounted units

(i) Contact thermostats

..... Fig. 5.2

(ii) Thermostat - TCO

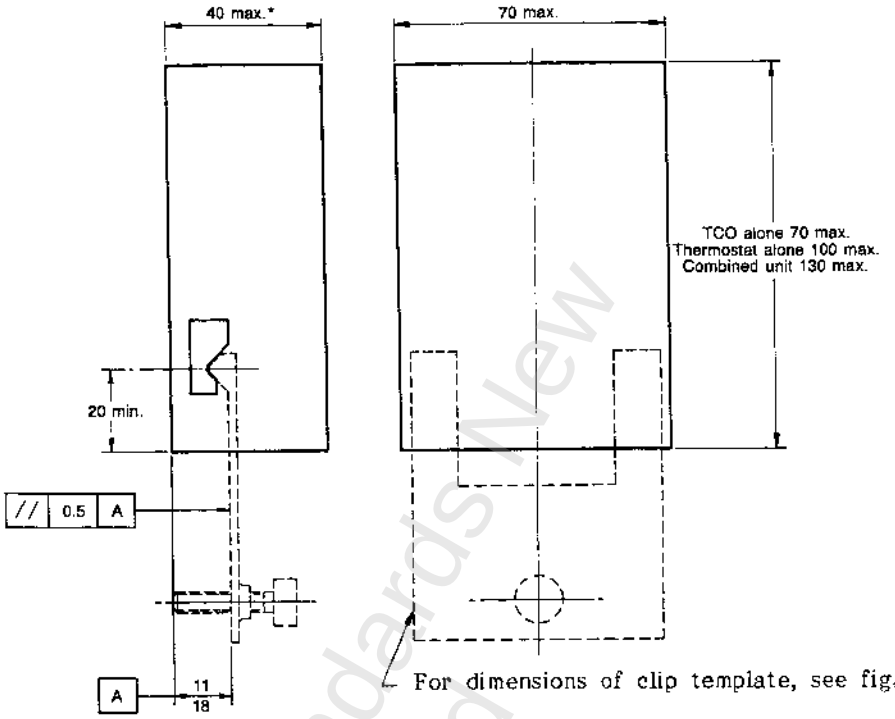
combinations..... Fig. 5.2

(iii) TCOs.....Fig. 5.3

5.2
Pockets for immersion thermostats
Pockets for immersion thermostats shall conform to the dimensions in fig. 5.4. Soft solder shall not be used in the fabrication of pockets. Those made of copper alloy shall be resistant to dezincification to the extent that the average depth of dezincification, determined in accordance with AS 2345, shall not exceed 300 µm longitudinally and 100 µm transversely.

6
ENCLOSURE

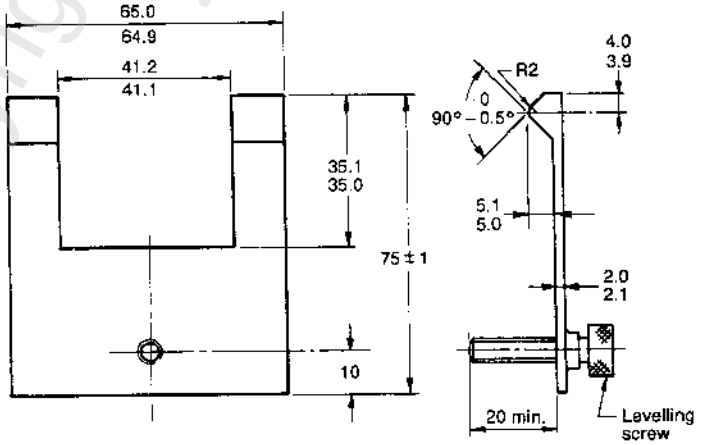
6.1
The live parts of the thermostat shall be protected by an enclosure. Under normal operating and service conditions the enclosure shall be suitable for the purpose and shall comply with those requirements of NZS 6200 which are applicable.



* Excluding items related to user-adjustment

DIMENSIONS IN MILLIMETRES

(a) CLIP-MOUNTED UNITS - LIMITING DIMENSIONS



DIMENSIONS IN MILLIMETRES

(b) TEMPLATE FOR CHECKING CLIP-MOUNTED UNITS

Fig. 5.1
CLIP-MOUNTED UNITS - LIMITING DIMENSIONS AND TEMPLATE

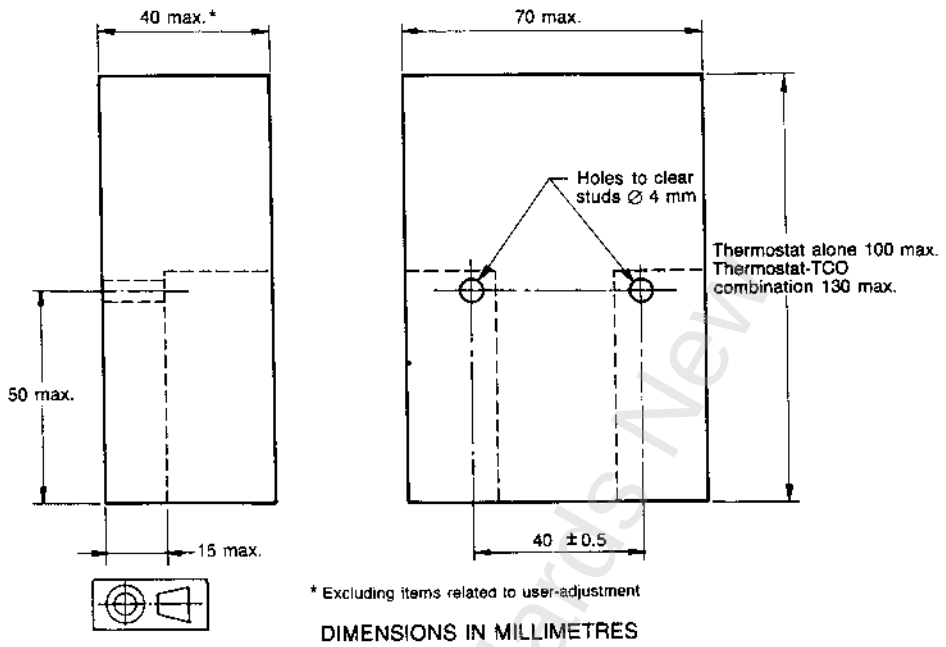


Fig. 5.2
STUD-MOUNTED CONTACT THERMOSTATS AND THERMOSTAT-TCO COMBINATIONS -LIMITING DIMENSIONS

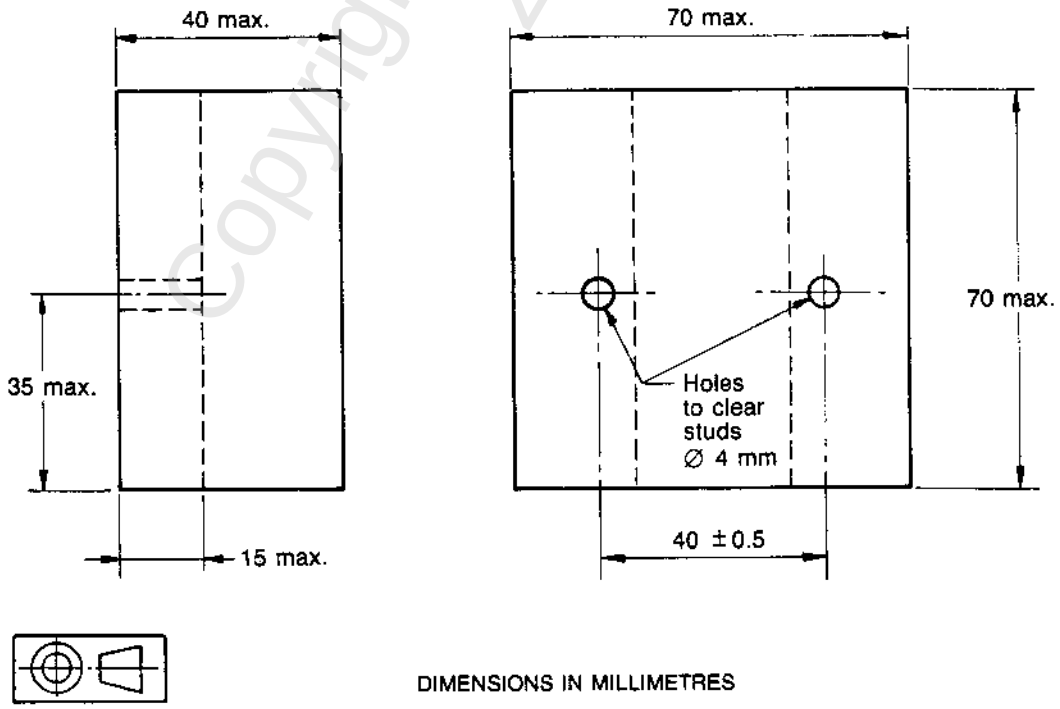


Fig. 5.3
STUD-MOUNTED TCOs - LIMITING DIMENSIONS

7
TEMPERATURE RISE OF CURRENT-CARRYING PARTS

7.1
Terminals and other current-carrying parts shall be so designed as to prevent excessive temperature rise due to the passage of current. Compliance shall be checked by the test given in 7.2 and the temperature rise of the terminals or terminations shall not exceed 45 °C.

7.2
Rewirable connectors are fitted with polyvinyl chloride insulated cables or cords as appropriate having a length of 1 m and a cross-sectional area of 1 mm² for 10 A connectors, 1.5 mm² for 16 A connectors 2.5 mm² for 20 A connectors, 4 mm² for 25 A and 32 A connectors, the terminal screws being tightened with two-thirds of the torque specified in the appropriate column of table 1. An alternating current of 1.25 times rated current is passed through the current-carrying contacts for 1 h. The temperature is determined by means of melting particles, colour changing indicators or thermocouples, which are so chosen and positioned that they have negligible effect on the temperature being determined.

8
RESISTANCE TO CORROSION

8.1
All component parts shall be of such materials and so finished that they will resist corrosion and distortion under normal conditions of use for the design life of the product which shall be taken as 50 000 cycles of operation.

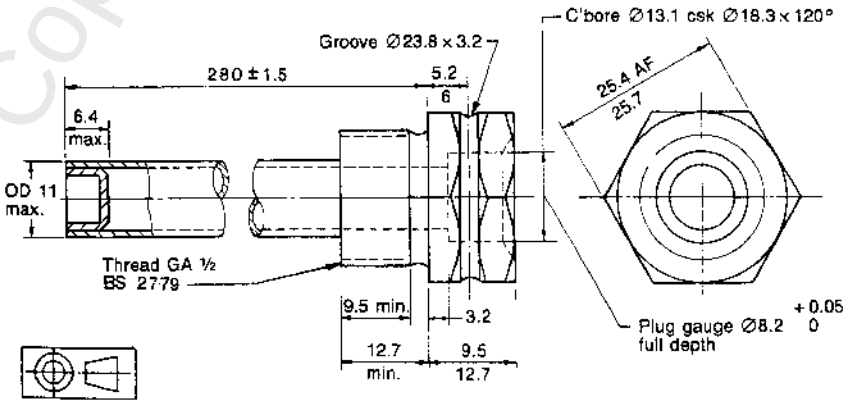
9
OPERATION OF THERMOSTATS

9.1
Nominal temperature differential
The nominal temperature differential shall be specified by the manufacturer and shall not exceed 10 °C.

9.2
Thermal operation

9.2.1
Cutout (operating) temperature
When tested in accordance with Appendix A the cutout (operating) temperature at each test temperature shall be between the temperature indicated or set on the thermostat and 5.5 °C below that temperature.

9.2.2
Temperature differential
When tested in accordance with



NOTE: Limits ± 0.15 mm unless otherwise shown.

DIMENSIONS IN MILLIMETRES

Fig. 5.4
POCKET FOR IMMERSION THERMOSTATS - LIMITING DIMENSIONS

Appendix A the temperature differential at each test temperature shall not differ from the nominal temperature differential by more than 2.5 °C, or 50 % of the nominal temperature differential, whichever is the smaller.

10
ENDURANCE

10.1
When tested in accordance with Appendix B, a thermostat shall:

(a) Be capable of continued operation

(b) Have an insulation resistance of not less than 2 MΩ across open contacts and not less than 5 MΩ in all other cases

(c) Have a cutout (operating) temperature on completion of the test which does not differ from its original value by more than 5 °C

(d) Have a temperature differential on completion of the test which does not differ from its original value by more than 20 %.

10.2
Where more than one voltage is marked on the thermostat, the test shall be carried out on separate samples of the same type to provide respectively, for the conditions of highest marked voltage with its associated marked current, and lowest marked voltage with its associated marked current.

NOTE - Attention is drawn to the need to comply with the Radio Interference Regulations and associated Notices.

11
OPERATION OF THERMAL CUTOUTS

11.1
Cutout (operating) temperature
When determined in accordance with Appendix C, the cut-out temperature of a TCO (including the TCO portion of a combined thermostat-TCO) shall be within 5.5 °C of the nominal setting specified by the manufacturer but shall not exceed 90 °C.

11.2
Replaceable parts
TCOs shall be of the non-self-

Table 7.1
TORQUE VALUES FOR TEMPERATURE RISE TEST

Nominal diameter of screw	Torque	
	Screws without heads (See Note)	Other screws and nuts (See Note)
mm	Nm	Nm
Up to and including 2.8	0.2	0.4
Over 2.8 up to and including 3.0	0.25	0.5
Over 3.0 up to and including 3.2	0.3	0.6
Over 3.2 up to and including 3.6	0.4	0.8
Over 3.6 up to and including 4.1	0.7	1.2
Over 4.1 up to and including 4.7	0.8	1.8
Over 4.7 up to and including 5.3	0.8	2.0
Over 5.3	-	2.5

NOTE - Values for screws without heads apply if the screw when tightened does not protrude from the hole, or if the use of a screwdriver with a blade wider than the diameter of the screw is effectively prevented.

resetting type and shall not contain replaceable component parts.

11.3
The TCO shall operate independently of any thermostat, but may utilize the same mounting facilities.

11.4
TCOs should not be used on open-vented water heaters that are connected to uncontrolled heat sources, such as wet backs or heating coils in solid fuel heaters, as these systems often reach boiling point by indirect heating.

12
DETERMINATION OF IGNITABILITY AND COMBUSTION PROPAGATION

12.1
Thermostats and TCOs shall pass the glow-wire test described in IEC 695-2-1, the glow-wire being at a temperature of 850 ±10 °C and applied for a period of 30 ±1 s. The thermostat or TCO passes the test if either of the following conditions apply:

(a) There is no flame and no glowing

(b) Any flames or glowing extinguish within 30 s of removal of the glow-wire.

13
MARKING

13.1
Information to be marked
Thermostats, TCOs, and combined thermostat-TCOs, that are intended for independent application (i.e. not intended merely as integral parts of an application) shall be legibly and indelibly marked on a suitable place on the device or its cover with the relevant information as specified in table 13.1.

13.2
Scale marking

13.2.1
Temperatures shall be marked in degrees Celsius. The upper temperature limit on the scale shall be between 65 °C and 80 °C and the lower temperature limit on the scale shall be not lower than 40 °C nor higher than 50 °C. The scale shall be graduated at even 5 °C intervals and at least 3 temperatures shall be figured on the scale, one close to the lower end, one close to the higher end and an intermediate marking. The height of the numbering shall be not less than 3 mm. The point against which the scale is to be set shall be clearly marked by an arrow or by an indelible mark fixed on the water heater case, the enclosure or the escutcheon plate, as appropriate. Clockwise rotation of the knob shall increase the temperature setting.

13.2.2
Where a thermostat has no 'OFF' position it shall not have any marking, e.g. 'O', which might imply that it has an 'OFF' position. Other marking in addition to that specified in 13.2.1, e.g. for frost protection, is however permitted.

Table 13.1
INFORMATION TO BE MARKED

Description	Thermostat	TCO	Combined thermostat-TCO
Name, or registered trade name or mark of the manufacturer	X	X	X
A catalogue number, type number, name, or other marking that will distinguish it from any other type of that particular class of device made by the manufacturer	X	X	X
Rated voltage	X	X	X
Rated current	X	X	X
Where suitable only for operation on either a.c. or d.c., the appropriate marking or symbol specified in NZS 6300	X	X	X
The 'OFF' position, if any	X	-	X
The normal position of mounting where this has particular significance	X	X	X
Such terminal markings as are necessary to ensure correct connection of the device*	X	X	X
Nominal temperature differential of thermostat*	X	-	X
Nominal cutout (operating) temperature of TCO	-	X	X

* Wiring diagrams and nominal temperature differential may be provided in manufacturer's literature.

APPENDIX A
METHOD FOR DETERMINING CUT-OUT TEMPERATURE AND TEMPERATURE DIFFERENTIAL OF THERMOSTATS

A1
Scope

This Appendix sets out the method for determining the cutout temperature and temperature differential of a thermostat.

A2
Principle

The thermostat is fitted in a specifed position to a standard test tank and operated through a number of normal thermal cycles. The temperature is measured at a specified position and the temperature differential calculated.

A3
Apparatus

The test tank shall conform to the dimensions and requirements specified in fig. A1 and shall be fitted to suit contact thermostats or immersion thermostats. The test tank shall be provided with a lid and a means of maintaining the water level at the height specified in A4. The temperature sensor shall be capable of measuring temperature to an accuracy of ±0.5 °C.

NOTE - The purpose of the standard test tank is to provide a method of measuring the comparative performances of thermostats (and TCOs), a method which is not influenced by different characteristics of different designs of water heaters. In addition it will provide a common point of reference from which thermostat suppliers and water heater manufacturers may establish specifications for calibration of thermostats and TCOs.

A4
Test procedure

The test procedure shall be as follows:

(a) Position the test tank in a test room at an ambient temperature of between 15 °C and 30 °C and not in a direct draught

(b) Fit the thermostat directly above the heating unit boss (see fig. A1). For a stud-mounted contact thermostat, the centre line of the mounting holes shall be 55 ±5 mm above the centre line of the heating unit boss

(c) Add cold water to a level so that at least 5 L is contained above the level of the top of the thermostat under test. Maintain this level throughout the test

(d) Set the thermostat to its maximum setting

(e) Energize the heating unit controlled by the thermostat so that the water temperature increases at a uniform rate of between 15 °C/h and 20 °C/h

(f) When the thermostat cuts out, allow the water temperature to cool naturally until the thermostat cuts in again

(g) Allow the thermostat to operate through not less than 6 complete ON-OFF cycles, recording cut-in and cut-out temperatures for the last 4 cycles as indicated by the specified temperature sensor

(h) Calculate the temperature differential for the last 4 cycles by subtracting the cut-in temperature from the cut-out temperature in each case

(j) Repeat steps (c) to (h) at settings of 50 °C and also at 65 °C where the upper temperature limit on the scale exceeds 65 °C.

A5
Report

The following shall be reported:

(a) The identity of the thermostat

(b) The thermostat settings tested

(c) For each thermostat setting:

(i) The cutout temperatures for the last 4 cycles.

(ii) The temperature differentials for the last 4 cycles.

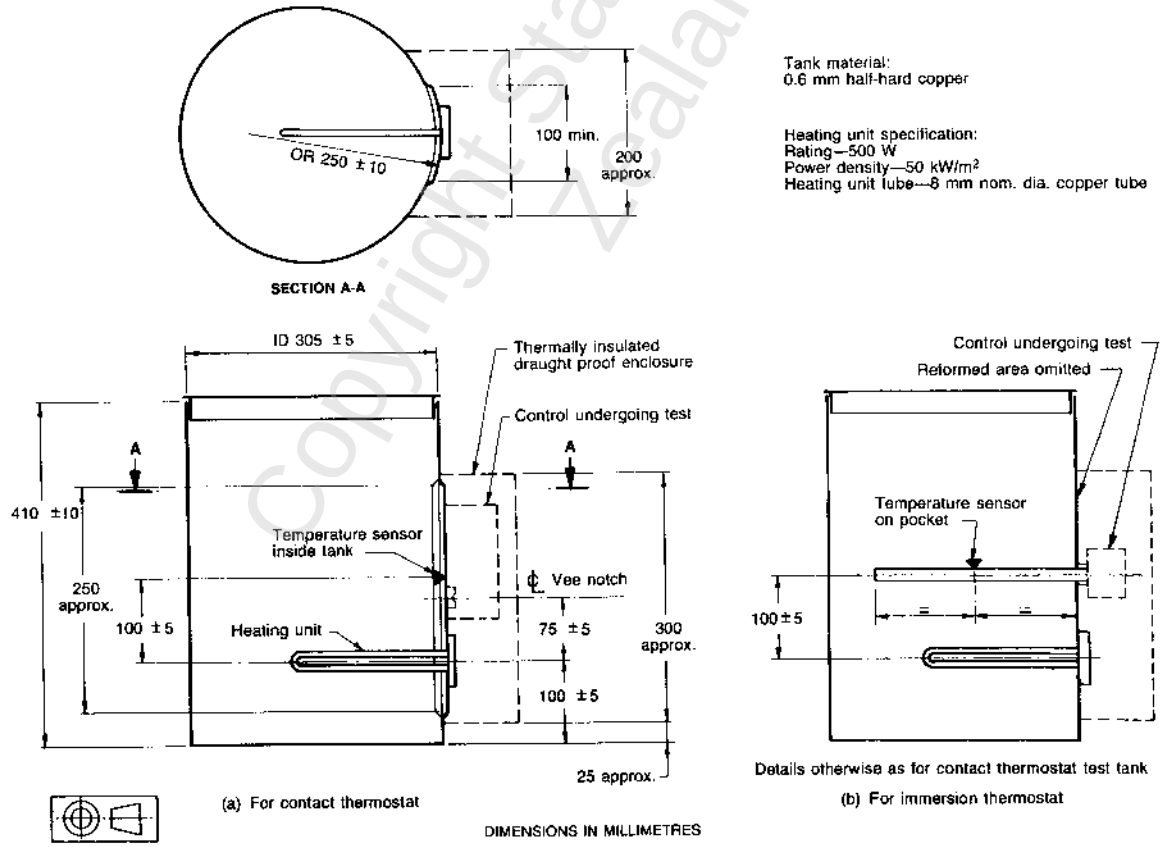


Fig. A1
STANDARD TEST TANK FOR THERMOSTATS AND THERMAL CUTOUTS

APPENDIX B
METHOD FOR DETERMINING THE ENDURANCE OF THERMOSTATS

B1
Scope
This Appendix sets out the method for determining the endurance of a thermostat.

B2
Principle
The thermostat is subjected to 50 000 cycles of accelerated thermal operation at one setting. Endurance is assessed in terms of continued operation, electrical integrity, change in cut-out temperature, and change in temperature differential.

B3
Apparatus
Means are required to apply heat to the thermally responsive portion of the thermostat to achieve accelerated cycling at a rate of not more than 6 cycles per minute.

B4
Procedure
The procedure shall be as follows:

(a) Condition the thermostat in an atmosphere of 95 ±5 % relative humidity at room temperature for 48 h

(b) Set adjustment to 65 °C on the scale

(c) Determine the cut-out temperature and temperature differential in accordance with Appendix A, recording the average values for the last 4 cycles

(d) Mount the thermostat for the test in a particular position if so required by the design of the thermostat

(e) Arrange the contact(s) to make and break a non-inductive load within 2 % of the rated voltage and current of the thermostat

(f) Commence accelerated thermal cycling; check contact operation at least every 5000 cycles; abandon the test if a contact fails to make or break correctly

(g) Stop cycling after 50000 consecutive switching cycles; check contact operation and note whether the thermostat is capable of continued operation

(h) Allow thermostat to cool and measure its insulation resistance in accordance with B5;

(j) Repeat step (c)

(k) Calculate the change in cut-out temperature and temperature differential.

B5
Insulation resistance test
Insulation resistance is measured at a voltage of 500 V d.c., in accordance with (a) to (e) below. For the purpose of this test, the contacts are opened and closed thermally or by a method which simulates thermal operation. The contacts are opened to the maximum position permitted by the design of the device where tests across open contacts are specified.

(a) The voltage is applied between live terminals and any metal parts which would be exposed when the device is mounted in position. This test is made with all exposed metal parts bonded together and with the contacts of the device open and closed

(b) The voltage is applied between live terminals and a metal support. For the purpose of this test the device is mounted, using the fixing holes provided, on a metal plate by means of metal fixing screws corresponding in respect of their diameter and size and type of head with the screws which would normally be used for fixing the device. The test is made with the contacts of the device open and closed

(c) The voltage is applied across the open contacts of the device,

between incoming and outgoing terminals, and, for a device having more than one pole, with all incoming terminals bonded together and all outgoing terminals bonded together

(d) For a device having more than one pole the voltage is applied, between each pair of poles with the contacts of the device open and closed

(e) For multi-way devices, sufficient tests are conducted to ensure adequate dielectric strength between 'ways' and across the open contacts of the device.

NOTE - Where the design of a multi-way device is such that the layout of the contacts of the device is symmetrical, it should not be necessary to test between all adjacent 'ways'.

B6
Report
The following shall be reported:

(a) The identity of the thermostat

(b) Whether the thermostat is capable of continued operation

(c) The insulation resistance

(d) The change in cutout temperature at 65 °C

(e) The change in temperature differential at 65 °C.

APPENDIX C
METHOD FOR DETERMINING CUT-OUT TEMPERATURES OF THERMAL CUTOUTS

C1
Scope
This Appendix sets out the method for determining the cutout temperature of a TCO (including the TCO portion of combined thermostat-TCOs).

C2
Principle
The TCO is fitted to a standard test tank in a specified position and operated thermally a specified number of times. The cutout temperature is measured at a specified position.

C3
Apparatus
The test tank specified in Appendix A shall be used.

C4
Test procedures
The procedure shall be as follows:

(a) Position the test tank in a test room at an ambient temperature of between 15 °C and 30 °C and not in a direct draught

(b) Fit the TCO as follows:

  (i) For combined thermostat-TCO fit as specified in Appendix A

  (ii) For separate TCO fit with the centre of the thermally responsive portion directly above the heating unit and at least 70 mm from the centre of the heating unit boss.

(c) Add cold water to a level so that at least 5 L is contained above the level of the top of the TCO under test. Maintain this level throughout the test

(d) Energize the heating unit controlled by the TCO (disabling any thermostat) so that the water temperature increases at a uniform rate of between 15 °C/h and 20 °C/h until the TCO cuts out. Abandon the test if the TCO fails to cut out by 95 °C as indicated by the specified temperature sensor

(e) Allow the water temperature to cool naturally to approximately 75 °C

(f) Manually reset the TCO

(g) Perform steps (d) to (f) 3 times. For a multipole TCO, check one cutout operation and observe whether all poles cut out within 150 cycles of the mains.

C5
Report
The following shall be reported:

(a) The identity of the TCO

(b) The cut-out temperature for each of the test cycles, or a statement that the TCO failed to cut out at 95 °C

(c) For a multipole TCO, whether all poles cut out.

OTHER NEW ZEALAND STANDARDS FOR WATER HEATING SYSTEMS

NZS 4602:1988	Low pressure copper thermal storage electric water heaters
NZS 4603:1985	Installation of low pressure thermal storage electric water heaters with copper cylinders (open-vented systems)
NZS 4604:1978	Dairy-type thermal storage electric water heaters with copper cylinders
NZS 4605:1978	Code of practice for the installation of dairy-type thermal storage electric water heaters
NZS 4606:0000	Mains pressure thermal storage electric water heaters (in preparation)
NZS 4607:0000	Installation of thermal storage electric water heaters: valve-vented systems (in preparation)
NZS 4608:0000	Control valves for use in hot water systems (in preparation)
NZS 4613:1986	Domestic solar water heaters
NZS 4614:1986	Installation of domestic solar water heating systems
NZS 4617:0000	Tempering valves (Three port mixing valves) (in preparation)
NZS 6205:1982	Energy labelling of household appliances
Part 2	The energy labelling of thermal storage electric water heaters

NOTES

NOTES

STANDARD CERTIFICATION MARK SCHEME

ing on a product, container or label is an assurance
ıanufactured under a system of supervision, control,
ıg periodical inspection at the manufacturer's works
ɔn Officers) designed to ensure compliance of the
, or practice with the relevant New Zealand Standard.
ındard Certification Mark, registered as a certification
ıe Trade Marks Act 1953, may be used only in terms
by SANZ, and must be accompanied by the licence
'S number.

ɔnjunction with advertising the 'S' Mark can provide
of product quality for a manufacturer when selling
becomes a powerful marketing tool.

obtain particulars of the conditions of licensing from
ards Association of New Zealand, Private Bag, Wel-

Declared on 27 May 1988 by the Standards Council to be a Standard specification pursuant to the provisions of section 23 of the Standards Act 1965.

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